FOUNDRY TRADE JOURNAL

Established 1902

WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 82 Thursday, July 3, 1947 No. 1609

49, Wellington Street, London, W.C.2

'Grams : " Zacatecas, Rand, London "

'Phone : Temple Bar 3951 (Private Branch Exchange)

PUBLISHED WEEKLY : 21s. per annum (Home and Overseas)

Nothing Adds up

We attended, at the recent conference of the Institute of British Foundrymen, a session devoted to the study of precision casting. Two Papers were submitted, one of British and one of American origin. Before and after the meeting we made inquiries as to whether there were any concerns manufacturing precision castings for the open market. The first response gave the name of a foundry in the Huddersfield area, but this was immediately denied by a second, suggesting a Sheffield concern. The managing director of this firm reminded us, however, that the only melting unit he possessed was of ten pounds capacity. He suggested a maker located in Slough, but soon we learnt that, in this case, a process was for sale. Thus we are still searching for a manufacturer prepared to receive inquiries for the open market. Then there was the question of costs. One speaker, pointing to a turbine blade, said the cost was of the order of £7 10s. each; he was followed by a second who talked of making 400 in one box and something was said of a price 7s. each. The margin was so wide as to leave one with an impression of complete bewilderment. The audience was shown a beautiful coloured film of the making of precision castings. Everything seemed so simple, so orderly, and so *perfectionné*, that here was a ready-made process awaiting its adoption by industry. Then the " film director " threw cold water on the whole process by insisting we had slavishly copied the Americans, that there was room for economies in every section, and that foundrymen should revamp the entire system. Only by so doing one could expect to make progress. Still there was ample evidence from other speakers that great strides had been made and a substantial gain had been registered in the furtherance of aeronautical engineering.

The meeting seemed to appreciate that, so far, nothing made sense, so a speaker suggested the formation of a committee of the Technical Council to exchange views. Unquestionably, several firms have developed an excellent technique, but for reasons somewhat obscure, they are unwilling to place their cards on the table. This attitude is untenable these days. Returning to the past, when there were four electric steel-melting furnaces in the country, the firms started up operations using a 50 : 50 pig-iron, steel-scrap charge, following open-hearth practice. Each one independently discovered that 100-per cent. steel-scrap charge was advantageous. Each one, by trial and error, found two slags were called for. If those metallurgists had met for discussion in those early days and exchanged experiences, it is reasonably certain that large sums of money would have been saved and that the process would have been commercialised in a fraction of the time it eventually required.

There is a niche in engineering for the precision casting; its amplitude will extend with the reduction of the selling price and the time of its true establishment will depend upon the exchange of views by those operating the process. The Institute offers a *venue*, where mutual enlightenment can be ensured without publicity until such time as all are agreed that the new development of this ancient process should form the subject of a Report. At the moment, we are sure that the engineering and foundry world would readily share our view that, on this subject, " nothing adds up."

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Vote of Thanks to Retiring I.B.F. President

In the course of the Annual Conference of the Institute of British Foundrymen, at Nottingham on June 17 to 20, the new PRESIDENT (Mr. P. H. Wilson) said that it was his great privilege to propose a hearty vote of thanks to the retiring President, Mr. Wood. They all knew the amount of work, the energy and the enthusiasm which he had shown not only during the immediate past year, but for the number of years with which he had been associated with the Institute. Mr. Wood had occupied the Senior Vice-President's chair for six years, and probably that was why he conducted the business of the Institute so well. Mr. Wilson only hoped he himself would be able to conduct the business as President of the Institute as well as Mr. Wood had done. There was one little matter which Mr. Wood had dealt with the previous year, and that was his offer to present prizes to members or, in other words, to create a competition, inviting schemes for improvement in the foundry industry. That had had a great response and had brought forth some very valuable suggestions. The council at their meeting the previous day had decided to have those reports selected printed for circulation, about which more would be heard later. He concluded by thanking Mr. Wood on behalf of everybody for the interest and the work which he had put in for the benefit of the Institute. The President's vote of thanks was seconded by Mr. J. J. Sheehan.

Awards and Prizes

Responding, MR. WOOD said when, 12 months ago, he accepted the honour conferred upon him, he had said he thought he could not do better than adopt the motto of the ancient Princes of Wales, "Ich Dien—I serve." The extent to which he had been able to carry out that motto had been possibly limited, but he could only say he had tried. With regard to the F. J. Cook Award, Mr. Wood said he knew the terms were somewhat onerous, and it was difficult in a general way to describe something that would personally benefit the industry, or to have the capacity to put into words an inspiration of the man who creates in his mind a single item of benefit in a particular way to the industry. He had not yet been given an opportunity of seeing the entries, beyond a casual glance, but hoped to study them in the future. Those to whom the awards were to be presented might be congratulated in securing a prize from a great number of competitors, and he did so wish to personally congratulate them on the excellence of their contributions.

The first prize of £75 was presented by Mr. Wood to Mr. H. Berry, Brighouse, Yorkshire, who said he felt greatly honoured with the award and trusted it would spur him on to still greater activity in his connections with the Institute. Prizes of £25 each were also awarded to:—Mr. J. R. Horton, Newark, Notts; Mr. J. Hird, Birmingham, and Mr. James Timbrell, Leeds. Mr. Hird replied on behalf of the prize-winners.

Hanover Trade Fair

The first export trade fair for the display of goods produced in the joint U.S./U.K. zones of occupation in Germany will be staged in the Vereinigte Leichtmetallwerke factory at Laatzen, approximately three miles from the centre of Hanover, from August 18 to September 7, 1947. The fair will be housed in four large buildings with a total covered area of approximately 24,000 square metres. The products displayed are expected to be immediately available for export or within a reasonable time.

Among the exhibits will be:—Electrical machinery and equipment, with electrical domestic appliances; fine mechanical and optical instruments and equipment; light metal products and hardware; general machinery; agricultural, building, printing, and food processing machinery. The Joint Export/Import Agency and the Board of Trade Purchasing Agency will establish a bureau on the site to give advice to British visitors on the handling of contracts.

British firms wishing to visit the fair should apply in writing to the Board of Trade, German Division, I.C. House, Millbank, S.W.1, giving details of products in which they are interested. Applications should be sent in not later than July 5.

Light Alloys in South Wales

The Proceedings of the South Wales Institute of Engineers (Vol. LXII—No. 3) contained an illuminating Paper, "Some Recent Advances in the Light Alloy Field," by Dr. H. Sutton. He first dealt with the wrought alloys, but devoted much of his Paper to castings, starting with D.T.D. 165 and D.T.D. 300A. Next he touched upon the various types of high silicon alloys, including the 11 to 12 per cent. and the 4 to 6 per cent. types. The Paper was well illustrated by tables and diagrams. The local branch of the Institute of British Foundrymen were present, by invitation, at the general meeting in Cardiff.

"*Industrial Wales*" *Exhibition*

This exhibition is being held at Olympia simultaneously with the Engineering and Marine Exhibition, (incorporating the Foundry Trades' and the Welding Exhibitions) in another section of this huge building. The two should not clash, but should be complementary; their duration is from August 28 to September 13 in both cases.

IN our May 22 issue, it is regretted that R. C. Tucker's paper, "The cupola as a precision instrument," was printed without the acknowledgment that it was originally presented to the Birmingham branch of the Institute of British Foundrymen.

— Institute of British Foundrymen —

Annual Banquet

Nottingham *June* 18, 1947

A suggestion that the time was now opportune for the return of a coalition government to Britain was made by Sir Harold Bowden, chairman of Raleigh Industries, Limited, speaking as principal guest at the annual banquet of the Institute of British Foundrymen, at Nottingham, on June 18. The banquet, held in the Greyfriars Hall, was attended by over 400 members and their wives.

Proposing the toast of "The City of Nottingham," MR. R. B. TEMPLETON, Senior Vice-President of the Institute, said when he had been asked some time ago to propose the toast by the East Midlands Branch, his mind immediately went back to the great historical past of the city and what a wonderful background it would make for a speech; what a wonderful opportunity for anyone having the time at his disposal, to tell all the things which had happened in Nottingham. It was there that a thousand years ago the Danes established the capital of their realm in England, and it was 200 years later that William the Conqueror, having captured the city, built the famous Castle which for 600 years was the centre of the most vivid events in English history. It was actually Edward I, at the beginning of the 14th century, who created the first Mayor of Nottingham. Then there were very many romantic stories of the bandit Robin Hood, whose chief pastime was to use the Sheriff of Nottingham as a target for his well-aimed arrows, and it had been said of Robin Hood that he could split a running hare at 250 paces and the Sheriff at 500 paces. Then, again, there had been the Goose Fairs and all the other fairs of Nottingham. It was at the Goose Fair, during the reign of Queen Anne, that the local dairymen, owing as they said to the increased cost of raw materials and labour, decided to raise the price of cheese, and the people objected. There was then none of the modern nonsense about arbitrations or referring to the Ministry of Food, but a good old English fight which developed into a riot. The Mayor of Nottingham in those days went down to intervene, and it was recorded that a woman leaning from an upstairs window hurled a cheese at him, struck him on the head and felled him to the ground in the very first over. What marksmanship! Arrows, cheeses and cocoanuts. Was it any wonder that such famous cricketers as Hardstaff, William Gunn, Arthur Shrewsbury, Larwood, and many others had appeared, with such ancestors?

The Institute was grateful to Nottingham for their courage in asking them to hold their annual conference in the city, because, like Notts County cricket, the industry was rather under a cloud. People said unkind and untrue things about it. It was suggested that it was a backward industry—it did not provide all the amenities which it should for its workmen. He denied that rather harsh indictment, but there was no smoke without a certain amount of fire, and the industry was, of course, trying to excuse itself by saying it was down-

Members and guests in this photograph taken of part of the top table at the I.B.F. Annual Banquet are, from left to right :—Sir Hubert Houldsworth (chairman, National Coal Board, East Midlands Division), Mrs. R. B. Templeton, Mr. R. B. Templeton (Senior Vice-President), the Lady Mayoress, the Lord Mayor of Nottingham, Mr. P. H. Wilson (President), Mrs. P. H. Wilson, Sir Harold Bowden, Mr. and Mrs. S. H. Russell, Sir Archibald Forbes (chairman, Iron and Steel Board), Mr. and Mrs. N. P. Newman, the Sheriff of Nottingham (Councillor H. O. Emmony), Mrs. H. O. Emmony and Mr. V. C. Faulkner.

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trodden and never had a fair deal from its master, the general engineering industry. He could not say how much lipstick and make-up of rouge and powder it was going to take to glamourise the industry sufficiently to lead it up to the altar and join it in holy matrimony with its lord and master the general engineering industry, but whatever it might cost, one was now beginning to think it would be well worth while bearing that expense if it only did one thing, and that was. remove the present unenviable and undeserved reputation. Mr. Templeton, in conclusion, said it was his very pleasant duty to thank the Lord Mayor for the charming hospitality extended to the Institute. He thought it would be agreed that many towns and cities might be perhaps better known than the City of Nottingham, but very few were better liked or could be more admired.

Nottingham's Progress

Responding, the LORD MAYOR (Alderman Robert Shaw, J.P.) congratulated Mr. Templeton on the handsome way in which he had endeavoured to convey to them the beauties and virtues of Nottingham, the Queen of the Midlands. He had given them a very eloquent historical survey and also suggested that the city's inhabitants had been a rather turbulent people, but they were not ashamed of that, because it showed out of their historical ancestry there had been handed down a virility of which they were proud. Continuing, he said there had been one sentence in the speech made by the immediate Past-President the previous evening that had rather intrigued him, that the city seemed to have taken out an insurance against heavy and continuous unemployment by the various and multifarious activities indulged in. That used not to be so. There had been a time when Nottingham had the reputation of being a lace city and had long experience as a one-trade town. Its citizens were proud of their virility and particularly proud that the city was at present the centre of the lace industry. During his own lifetime, Alderman Shaw had seen the beginning of Raleigh Industries, Limited, which had been the foundation of the industry of which Nottingham were proud to be progenitors. By this insight into what Nottingham really was, he hoped to show them that, with such a history, Nottingham inhabitants were determined they would equal their ancestors, if not better them, and for that reason they were proud of the workmen and of the city itself. In expressing the hope that conference delegates would take the opportunity of seeing as much as possible of city life, the Lord Mayor remarked they were particularly proud of all the developments at present taking place. Actually, Nottingham's greatest asset was not its council house, but its council houses, where its citizens were being made and developed, and in view of their educational system, he had every faith in looking forward that Nottingham would retain its ability to hold its place in the world.

Supply Shortages

SIR HAROLD BOWDEN, proposing "The Institute of British Foundrymen," presumed his task would give him an opportunity of taking a certain amount of licence to discourse on other subjects and, incidentally, to ventilate a few ideas that accumulated in his mind, especially during the present very trying times. He took it that, on such an occasion, there was probably only one subject taboo—straight politics. The fact that members were holding their 44th Annual Conference was indeed a fine record of continuity, and he was pleased and gratified that they had been able to make the city of Nottingham the venue of their deliberations this year. In common with other cities of industrial importance, Nottingham had had a great opportunity of exceeding all previous efforts, but industry recently had received a terrible blow, due to the shortage of coal, which, of course, was the crux and dominated the whole situation. Without coal they could not have steel, and steel was the all-important factor in so many industries. He imagined foundrymen in their own industry would have felt it more acutely probably than any other in the country. The coal shortage, he added, obviously was one of those things that should have been foreseen two years ago, when householders were even then rationed in their domestic life, and steps should have been taken so that the future should have been safeguarded. Unfortunately, this was not done, and the position could hardly be worse. One heard exhortations from Sir Stafford Cripps and other members of the Government urging us to produce more. Just imagine Sir Stafford Cripps or any other member of the Government telling us this. What was business but to produce, and produce more, and if possible to go on breaking records? That was exactly what private enterprise did, but it would not do it without coal, steel, timber and labour, and it was useless trying to exhort the people to increase production unless industry could have the essentials.

The position of industry to-day was difficult, he went on. It could not control the overhead charges on which profits or losses depended, and unreasonable selling prices. Those who believed in private enterprise as opposed to national control or ownership of industry might be interested to learn something in connection with that subject, as he (the speaker) had done, when in France two weeks previously. Only one motor-car factory so far had been taken over by the Government, the famous Rénault works, and their cars in competition with other French motor-car manufacturers were being sold at a loss of 20 per cent. Sir Harold said he had received this information from a high authority and had been informed it was well known in industrial circles. One could just imagine what was going to happen in this country if and when the Government ideology had taken its shape in things to come.

Quality of Goods

Appealing to British manufacturers, Sir Harold added that there was one thing that the manufacturers of British goods must never lose sight of, and that was the necessity of always maintaining high quality, espe-

cially in export trade. He mentioned this because there had been a tendency in some quarters to take advantage of the sellers' market abroad by sending out goods not up to British standard, thus doing the reputation of British production a bad turn. Overseas business had been built up on quality, and that was something of which to be proud and something that must be continued and maintained.

Extending his heartiest congratulations to the Institute, Sir Harold said he understood that, incorporated by Royal Charter and founded in 1904, it was not concerned with trade or commercial matters, but the technical organisation of a very ancient industry built up through years of experience, craftsmanship and empiricy. He remembered, when going round the world in 1935, in China and Japan being struck by the magnitude and beauty of the castings carried out by the people of those ancient countries hundreds and hundreds of years ago. It was indeed a very ancient and honourable industry. The Institute's membership consisted mainly of directors, managers and metallurgists supplied by some 180 firms who subscribed to the Institute and thereby supported its work by their membership. The work of the Institute was not only highly technical and scientific, but included among its many activities, encouragement and technical training of foundry personnel, which in his opinion was one of the most important items in the work they did.

The President of the Institute was one of the best-known figures in the industry and had been associated for many years with national work connected with the foundry business. As a foundry technician, his name would always be associated with the development of that remarkable invention, the centrifugal process of making cast-iron pipes, for which work he had been awarded the E. J. Fox medal of the Institute. In proposing the toast, Sir Harold expressed the hope that the Institute would go on from strength to strength, continuing to flourish and expand.

Essential Technical Organisation

Replying on behalf of the Institute, the PRESIDENT (Mr. P. H. Wilson, O.B.E.) congratulated Sir Harold on the comprehensiveness of his knowledge of the Institute. Mr. Wilson, however, was afraid in the earlier part of his speech, Sir Harold had painted a rather gloomy picture of the present position, but they had to face facts, and it was only by doing that and realising the difficulties to be faced that they would prepare themselves to overcome those difficulties. As foundrymen, they all felt that they were capable of doing that. With regard to Sir Harold's references to himself, the President could only say he was just an ordinary foundryman doing his bit, and he was very conscious of the responsible position in which he had that day been placed. As far as the Institute was concerned, they had a membership of approximately 4,000, and there was no doubt the rate of increase had been very steep during the last four or five years. The reason for that, he considered, was that members or people concerned in the industry were realising that technical organisation was essential perhaps more to-day than ever in the past, and it was hoped membership would increase still more. Revised conditions, it was hoped, would not only increase membership among the technically-minded foundrymen, but would be an ultimate benefit to both the Institute and the country.

The Institute's primary object was to promote a higher standard of technical knowledge. On the controversial subject of the Government control of industry, he suggested, with due respect to all those concerned, that the rate of progress in technical development, particularly in the case of larger organisations, might well become either the declared attitude of the Government or by inference. Within the Institute, they had the most expert knowledge of the industry, and that experienced knowledge of the various crafts with which they were concerned had a history extending back in the East many thousands of years. Products of ferrous and non-ferrous castings were essential in the construction of plant and machinery to almost every other industry in the country, and in view of the wide range of castings produced, the foundry industry was perhaps the most complicated in the whole of the iron and steel trade.

Members were quite aware there was room for improvement and development in their industry, and much thought had been given to those matters during the past few years. The complexity of the industry made it imperative that the introduction of any form of reorganisation could only be effected by those most qualified to undertake such work. None of their members was opposed to new ideas; in fact, they wanted them, and any suggestion towards improvement would have the wholehearted co-operation of them all; but if they were to be controlled or otherwise directed by individuals lacking the knowledge of the industry, then he was afraid further practical development would be retarded. The President thanked Sir Harold on behalf of the Institute for joining them and for his very wise remarks with regard to the conditions appertaining to the foundry industry and industry generally, and in conclusion said he wanted to take the opportunity of conveying to the officials and secretaries of the Institute his most sincere thanks for contributing so much in ensuring the success of the conference.

The Foundry Industry

The last toast of the evening, "The Guests and Ladies," was proposed by MR. S. H. RUSSELL, a Past-President of the Institute. Those living in the East Midlands, he said, were proud not only of the industrial capacity of the area, but also of their particular portion of England. The many and varied phases of industrial activity represented at the banquet by their guests were an indication of the importance of the vital basic industry which they were all so proud to serve. Until recent years, the foundry industry was very disorganised, but had two powerful redeeming features. First, the Institute of British Foundrymen had always had a strong membership and a powerful influence in the East Midlands area and linked together the personnel of many foundries who would otherwise have never met, whose co-operative efforts raised the whole status of the industry and by interchange of knowledge

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and ideas, facilitated the rapid application of technical knowledge. Secondly, the formation of the British Cast Iron Research Association had enabled the more enlightened foundries to take full advantage of the application of fundamental research in their somewhat complex industry. Members of the foundry trade had at last seen the wisdom of combining in order that they might mutually solve the many problems raised during the war, and subsequently as a result of the war.

Mr. Russell said that they were particularly pleased to welcome Mr. FitzHerbert Wright, Chairman of the Council of Ironfoundry Associations, and Mr. F. G. Burrell, President of the Association of Bronze and Brass Founders, both of whom represented important and powerful trade associations which had been constituted in the last few years, and which had added to the complexity of life by demanding the interpretation of such initials as the J.I.C., C.F.A., N.I.E.F., etc. He was also sure that Sir Archibald Forbes, whose presence was very welcome, was pleased to find that there existed in the foundry industry, representative bodies who could intelligently discuss with him and with his board, the many difficulties which faced the iron and steel industry at the present time. It was outside the scope of the toast to go into any details as to the difficulties in co-ordinating the views of nearly 2,000 ironfoundries, not to mention steel, bronze and light alloys, whose problems were, of course, almost identical, but when Sir Archibald looked around and saw all the intelligent and enlightened men engaged in the foundry industry, he would not despair of ultimately finding it practicable to guide them through the new conditions which faced not only their own, but all heavy industries.

There had been full co-operation between the trade associations, the Institute of British Foundrymen and the British Cast Iron Research Association, and while the Institute would thrive upon the individual support of its many members, those who were interested in obtaining much more financial support for fundamental research were hoping to see the time when the burden would be spread over industry generally, instead of being borne by the willing and public-spirited firms only. After all, the results of fundamental research reached all sections of industry, and it was only justice that the whole of industry should contribute its share. The presence of Dr. H. Hartley, President of the British Cast Iron Research Association, was also welcome. He had ever the interests of the Research Association at heart, had taken a prominent part in the management of its affairs, and it was very fitting that he should be the President during the celebration of its silver jubilee. After a graceful acknowledgment of the assistance which the civic authorities had given in according to members a welcome to Nottingham, Mr. Russell asked that members should couple with the toast the name of Sir Hubert S. Houldsworth, chairman of the East Midlands Division of the National Coal Board.

Concluding, he said that the industry intended to use a scientific approach, and with an open mind attempt to economise in the use of every form of fuel, but it must be understood that a cupola was a very efficient piece of melting apparatus, and that if supplies of cupola coke had to be reduced, then automatically the output of iron castings would immediately fall in exact proportion to the cut in cupola coke. It was to their advantage that men of the ability of Sir Hubert were prepared to work on this vital problem, and he wished him every success in his responsible position, and yet was concerned that he should confine his efforts in operating a nationalisation scheme in the realm of fuel only, and that he and his colleagues would leave the industry to work out its own salvation which, incidentally, it was confident that it was fully capable of doing.

Groups Represented

SIR HUBERT S. HOULDSWORTH, responding on behalf of the guests, said it would indeed require a paragon to reply on behalf of the many distinguished guests which the proposer of the toast had referred to as well as those who had not been specifically mentioned, and as he did not claim to be a paragon, he was therefore woefully unfit for the task. The guests seemed to be divisible into a number of groups. There was the distinguished body of members of the Corporation of Nottingham and their officials who represented that which was best in the local government of this country; there were others who represented learned societies and trade associations, whose contribution to industry could not be over-estimated; there was, too, Prof. Peers, acting Principal of University College, who also added lustre to the distinguished body of thinkers who made their contribution to national life; and then there were many who were representative of different branches of private enterprise and particularly those spheres of such activities related so much to the work of the Institute. Sir Hubert added he had wondered what the reason was for the invitation for him to speak. Perhaps it was that his board had the designation of " East Midlands " which was so much to be desired, or it might be that they had wanted the opportunity of examining the strange sort of individual who associated himself with a nationalised industry; or—and perhaps this was more likely—it might be because there was an ingrained idea growing intensely that the National Coal Board was responsible for all the sins of omission and commission by whosoever committed in this country. At any rate, whatever the reason, he assured Mr. Russell he was in no danger of interference from either himself or his colleagues in other branches of industry. The Coal Board had got a full-time job with the task that had been given to them, and if as a result of the co-operation they got from the technical people and the mineworkers in the industry they could give to other industries the coal so essential to their activities, they would indeed have done their task without trespassing one step beyond their boundaries. However impossible he found it to reply on behalf of such a galaxy of talent, Sir Hubert found it an easy task to say thank you to the Institute for the generous hospitality which they had provided—nothing had been neglected.

After the dinner, members were entertained by a cabaret, followed by dancing.

Precision Casting of High Melting-Point Alloys Containing Nickel*

Part I

By H. Evans, A. Met., F.I.M., P.S. Cotton, B.Sc. and J. Thexton, A.Met., A.I.M.

This Paper is based on an investigation carried out to develop a technique suitable for the manufacture of castings by the "lost-wax" process in high melting-point nickel alloys. A procedure based on the use of zircon flour in the sprayed coating and of sillimanite in the investment is recommended.

The development of precision casting by the "lost-wax" process for engineering purposes has been described[1] [2] as one of the outstanding wartime achievements in the foundry. Essentially the process consists in making a wax pattern of the component to be cast, coating the pattern with a fine-grained refractory material, investing it to form a refractory mould and melting out the wax, thereby leaving the cavity into which the metal of the casting is poured.

The "lost-wax" process has a long history in relation to statuary and jewellery and has also been employed for many years in prosthetic dentistry. Application of the process to engineering purposes was developed in the early war years and precision casting has since become of increasing interest for the production of engineering parts which for economic or technical reasons do not lend themselves to machining, or for which adequate machining facilities are not available, but in which close dimensional accuracy and surface-smoothness are essential.

The "lost-wax" process consists of ten stages:—

(1) *Preparation of a master-pattern* in an easily machinable material, such as wood, steel or brass, to the design of the component of which it is required to prepare numerous castings, but made oversize on all dimensions (to an extent arrived at by experiment, but often around 2 per cent.) in order to allow for shrinkage during the later stages of the process.

(2) *Preparation of a split master-die,* from the master-pattern, in a low melting-point alloy, or in rubber. Where the component is simple in shape it may be unnecessary to use the above stages. Instead it may be possible to prepare the split die in steel or brass by normal machining operations.

(3) *Preparation of wax patterns,* by injecting wax into the master-die. The necessary wax patterns of gates and risers, to enable adequate feeding of the castings, are made separately in a similar way or by pouring molten wax into moulds having cavities of the desired shapes.

(4) *Joining wax gates and risers to wax patterns,* by the use of a heated spatula, and attachment of the inverted wax assemblies to a waxed base plate.

(5) *Application of a refractory coating,* by dipping or by spraying with a finely crushed refractory suspended in a liquid binder.

(6) *Investment of coated assemblies,* in a container, in a refractory suspended in a liquid binder. The container is vibrated.

(7) *Drying of invested assemblies,* at a temperature below the "melting-point" of the wax.

(8) *Melting-out wax patterns* from the invested assemblies, followed by firing the moulds by heating slowly to a temperature which is dependent upon the intricacy of the casting to be made and on the pouring temperature of the alloy employed.

(9) *Pouring the molten alloy* from the melting furnace into the cavity of the hot mould.

(10) *Extraction of the casting,* when cold, from the mould, and removal of the gates and risers, followed by cleaning the surface of the casting by shot-blasting.

For statuary and dental applications, use was made until recently of plaster of paris and silica as an investment mixture, and no steps were usually taken to provide a highly refractory coating at the surface of the mould. In 1934, the Austenal Laboratories, Inc., described a process[3] in which the investment mixture consisted of silica or similar refractory oxides suspended in an organic silicate. Moulds made in this way have been used on a very large scale, particularly in America, for engineering alloys of moderate-to-high melting-points. Where the melting-point of the alloy or the degree of superheat necessitated by limited fluidity in the alloy or by the intricacy of the casting is such as to demand a pouring temperature above a certain maximum, the use of silica is, however, not always completely satisfactory.

The work described in this Paper arose primarily in connection with the development, for high-temperature applications of the alloy which has been given the designation "Nimonic 80." This alloy, when cast in the form of turbine blades, proved to need a higher pouring temperature than the maximum permissible when using silica as a refractory.

An investigation was therefore undertaken to study the possibilities of extending precision casting to materials of high pouring temperature, with the object of developing a process which was suitable for all high-nickel alloys. This investigation has proceeded in conjunction with research on the selection and control of the most satisfactory composition for "Nimonic 80"

* Paper read at the 44th Annual Conference of the Institute of British Foundrymen at Nottingham, June 19.

Precision Casting

when used in cast form, and the incorporation of high-frequency heating of the metal while in the mould, to reduce the degree of initial superheat necessary.[4] A Paper[5] published in 1945 gave a historical survey of the "lost-wax" process and referred to the early progress of the laboratory investigation, which led to the development of a procedure involving the use of mixtures of sillimanite sand of stated grain-sizes and ethyl silicate, diluted with methylated spirit, for the coating of the pattern and as the material of the invested mould.[6] The present Paper describes the investigation as a whole, and includes recommendations for an improved procedure for the production of precision castings in the class of alloy referred to above.

Defects in Precision Castings

In order to make clear the need for modification of the "lost-wax" process when dealing with the class of high-temperature material under discussion, reference is made below to some of the types of defects which were encountered in the early stages of the investigation.

(*a*) *Incomplete Running*

Fig. 1 illustrates a high-nickel alloy casting poured, at 1,600 deg. C., into an invested mould preheated to 850 deg. C. The thin edge of the blade could not be run completely using these temperatures. With the high mould- and pouring-temperatures needed for thin castings, a silica-sodium silicate coating is not sufficiently refractory.

(*b*) *Rough Surface*

The appearance of the surface of high-nickel alloy test-bars prepared in moulds with a silica-sodium silicate coating is shown in Fig. 2. The rough surface of the castings, due to fusion of the coating by the alloy, is evident.

Laboratory Investigation

Preliminary study of the "lost-wax" process indicated that the necessary improvements would probably be most readily secured by modifications of:—(1) The binding agent of the refractory mould and the pattern-coating, and (2) the refractory of the mould and of the coating of the wax pattern.

The production of patterns has been carried out with a red injection wax, type No. 4, developed by Associated (Dental) Products, Limited, in co-operation with The Royal Aircraft Establishment, Farnborough, and brought to the Authors' attention by the Ministry of Aircraft Production. To withstand handling, it is necessary that the wax is not brittle, and therefore liable to chip readily; it must be hard and have a reasonable toughness. Further, the wax must have a low shrinkage when it solidifies and a low thermal expansion, and it should not leave any residue after burning, in view of the possibility of burning of residual wax left in narrow passages and corners after melting-out.

The Binding Agent

The process demands that the mould and pattern spray coating should be strong and should not crack, transform or dissociate on heating, and, in addition, that the investment and pattern spray should bond well together, that the coating should not react with the molten alloy, and should be capable of withstanding the erosion of the stream of molten alloy when poured from the furnace at a high temperature. The binders used to produce the two mixtures can influence the required characteristics, so that, for any refractory chosen as the base of the coating on the wax pattern or for the mould material, it is necessary to investigate the type of binder which is to be employed to knit together the refractory particles. For the pattern spray, a thin liquid binder is essential.

Sodium silicate was first selected for experimentation but although this binder, used in conjunction with either silica or sillimanite, will enable brass or bronze, etc. castings with good surfaces to be made, little success was obtained when high-nickel alloys were poured at temperatures of 1,540 to 1,600 deg. C. into cavities faced with mixtures of this sort. It was appreciated that the refractoriness of the silica and sillimanite was impaired by the presence of a compound of sodium, as the surfaces of the "Nimonic 80" test-bars and blades were rough and showed evidence of fusion having occurred with the refractory.

In view of the apparent limitations of sodium silicate, attention was turned to silicon ester[7] or tetra-ethyl silicate, which appeared to offer possibilities as a binder. King[8] had described the properties of this material in a paper to the Oil and Colour Chemists' Association in 1930. When water is added to the tetra-ethyl silicate, the silicate undergoes hydrolysis and, depending upon the amount of water added, silica or

TABLE I.—*Effect of Diluting the Ethyl Silicate Stock Solution with Methylated Spirit on the Susceptibility of the Sprayed Coating to Cracking.*

No.	Ratio of ethyl silicate stock solution to methylated spirit by volume.		Spray mixture.	Air-dried 3½ hours and treated with :—	
	Stock solution.	Meths.		Ammonia. 2 per cent.	Ammonia. 5 per cent.
1	1	2	20 ml. binder to 25 gms. Sillimanite (FF grade)	Bad cracking	Bad cracking
2	1	3		,,	,,
3	1	4		No cracking and hard	Some cracks
4	1	5		,, ,,	No cracking and hard
5	1	6		,, ,,	,, ,,
6	1	7		No cracking, powdery	No cracking, powdery
7	1	8		,, ,,	,, ,,

silicic acid is precipitated, with the formation of alcohol, thus:—

$$Si(OC_2H_5)_4 + 2H_2O = SiO_2 + 4C_2H_5OH$$

or

$$Si(OC_2H_5)_4 + 4H_2O = Si(OH)_4 + 4C_2H_5OH$$

When a powdered refractory is mixed with a freshly prepared solution of ethyl silicate and methylated spirit the reaction proceeds, the alcohol is volatilized and the silica is first deposited round the particles of refractory, as a colloidal gel. As the gel dehydrates, the mass slowly hardens and eventually becomes one of high strength. The rate and completeness of the reaction are influenced by temperature, by factors in the composition of the solution, such as the presence of electrolytes, and by the screen analysis of the refractory.

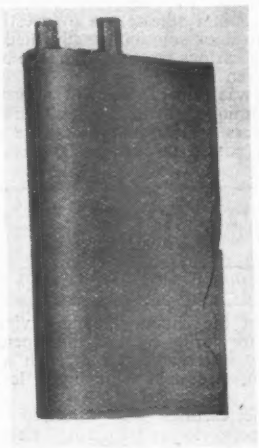

FIG. 1.—AN INCOMPLETELY RUN TURBINE BLADE.

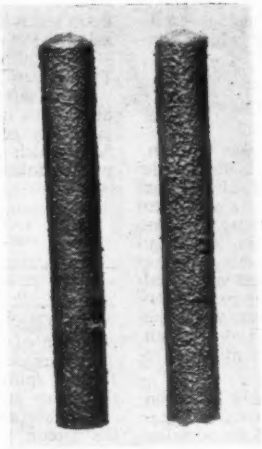

FIG. 2.—TEST-BARS PREPARED IN MOULDS WITH A SILICA-SODIUM SILICATE COATING.

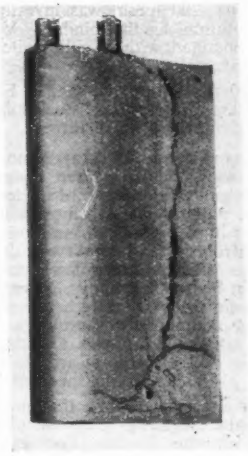

FIG. 3.—VEINING ON THE SURFACE OF A TURBINE BLADE.

In the present investigation, a stock solution of ethyl silicate was used, which contained by volume:—

Condensed ethyl silicates (containing 40 per cent. silica)	75	per cent.
Water	7	,,
Ethyl alcohol	18	,,

The major part of the laboratory work has been carried out using this stock solution (with added methylated spirit) as the binder, and has included experiments using the refractories referred to later in the text, which served to determine the optimum proportions of stock solution and methylated spirit to act as a binder for the investment mixture and for the coating mixture, as judged by the strength of the dried and fired refractory mixtures, the adhesion of the coating to the mould, and the surface-smoothness of the castings. Typical results for sprayed coatings made with varied ratios of ethyl silicate stock solution to methylated spirit and subjected to treatment with ammonia, to accelerate hydrolysis, are given in Table I.

A small addition of hydrochloric acid to the binder was found to accelerate more effectively the hydrolysis of the ethyl silicate. The proportions of stock solution to methylated spirit which were found to be most satisfactory as a result of these further tests, are given at the end of the Paper, with other recommendations for the conduct of the precision casting process.

Refractories

Since the characteristics of the refractory materials used as bases for the pattern-spray and investment mixtures were expected to be the main factor in controlling the behaviour of the finished mould, attention was given, in selecting refractory materials for study, to the aspects enumerated at the head of the last section. These considerations led to the concentration of effort on refractories of high fusion-temperature and limited tendency to transform or dissociate, as exemplified by sillimanite and zircon (zirconium silicate).

(*a*) *For Coating of Wax Pattern*

Silica flour as the refractory, and sodium silicate as the binder, were first tried in dip and spray mixtures for coating the wax patterns. These were invested in a mixture of silica sand and silica flour with (*a*) sodium silicate, and (*b*) ethyl silicate. As already mentioned,

Precision Casting

no completely satisfactory high-nickel alloy castings were produced with the sodium silicate binder. The surfaces of the castings were rough and there was evidence that some fusion of the silica coating by the molten alloy had taken place.

The substitution of ethyl silicate for sodium silicate as the binder in the coating did not materially reduce the general surface-roughness. It was obvious that a satisfactory surface-finish on high-nickel alloy castings could not be obtained by the use of silica as the base of the coating and a more suitable refractory had to be found.

A range of refractories, including fine carborundum sand and sillimanite sand, FF grade (containing 98 per cent. of −200 mesh) was investigated, with ethyl silicate solution as the binder. Very promising results were obtained with a sillimanite mixture which consisted of:—

100 gm. Sillimanite sand, "FF" grade.
10 ml. Ethyl silicate stock solution.
46 ml. Methylated spirit.

This mixture was sprayed on to the wax pattern, which was held at a fixed distance from the nozzle of the gun and afterwards dried in still air. The coated pattern was then immersed for about two minutes in a 2-per cent. ammonia solution, to accelerate hydrolysis, and again air dried before investing. Castings, such as creep test-pieces and turbine blades, made in high-nickel alloys, generally showed very good surface-finish. A slightly better yield in the production of these components was obtained, however, when the dilute ammonia dip was abandoned in favour of an addition of hydrochloric acid to the spray mixture, to give a *p*H value within specified limits.

Over a period of time the sprayed coating based on sillimanite did not give consistently the desired surface-finish on the blades. For example, slight veining occurred on a proportion of the blades, as a result of the cracking of the coating, and further work was considered advisable to determine whether a more suitable refractory could be found as the base of the coating.

TABLE III.—*Properties of Refractories Used as Sprays.*

Refractory.	Fusion Temp. Deg. C.	Transformation or Dissociation. Temp. Deg. C.	Transformation or Dissociation Products.	Density.
Silica ..	1,710			2.65
		870	Tridymite ..	2.26
		1,470	Cristobalite ..	2.32
Sillimanite ..	1,810			3.3
		1,550-1,625	Mullite ..	3.16
			Silica Glass ..	2.3
Zircon ..	2,430			4.5
		1,600-1,800	Zirconia ..	5.8
			Silica Glass ..	2.3

A further series of refractories, including graphite and mixtures of graphite and "FF" sillimanite, and zircon flour (essentially zirconium silicate) were investigated, using the ethyl silicate stock solution—methylated spirit—hydrochloric acid in various proportions as the binder. Typical results are given in Table II.

From this series it was evident that, with appropriate alterations in the technique, zircon flour[9] was likely to give very good surfaces. The analysis of the zircon flour which could be passed through a 200-mesh sieve was as follows:—

ZrO_2 Per cent.	SiO_2 Per cent.	TiO_2 Per cent.	Fe_2O_3 Per cent.	Al_2O_3 Per cent.	CaO Per cent.	MgO Per cent.	Moisture Per cent.
66.80	32.33	0.23	0.33	Nil	Nil	Nil	0.15

The high density of the zircon demanded vigorous agitation of the mixture during the spraying operation. This was achieved by introducing air through a perforated spiral tube inserted below the liquid level in the spray gun.

The surface of the castings was improved when the zircon was subjected to a stabilising treatment at 1,300 deg. C. for 2 hrs. A further series of experiments showed that a thick coating on the pattern resulted in improved surfaces of the castings. Thick coatings could be produced by:—(*a*) Subject-

TABLE II.—*Influence of Coatings on the Surfaces of Castings.*

Spray No.	Pattern spray formula. Refractory. Gm.	Ethyl silicate stock solution. Ml.	Methylated spirit. Ml.	10 per cent. hydrochloric acid in methylated spirit. Ml.	Appearance of coating after drying.	Remarks.
10	Graphite 100	60	101.6	18.4	Soft and powdery	On melting-out wax patterns, large areas of the coating had been removed. Not cast.
11	Graphite 50 "FF" sillimanite 50	24	40.8	7.2	Harder than No. 10 but still rather powdery	As No. 10, but less coating removed. Not cast.
13	Zircon flour 100	17	28.2	5.2	Hard	Surface of casting very smooth.

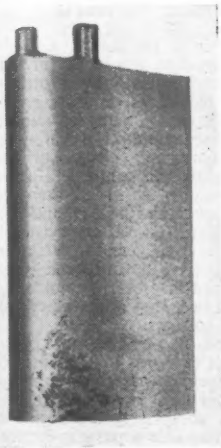

FIG. 4.—POROSITY AT THE SURFACE OF A TURBINE BLADE.

FIG. 5.—RIPPLED APPEARANCE OF THE CONCAVE FACE OF A TURBINE BLADE.

ing the wax pattern to a double spraying operation, the first coating being allowed to dry for 12 hrs. before applying the second coating, or (*b*) spraying the pattern with zircon and drying for various times, followed by a dip in the sillimanite investment mixture. The time which was required for the drying of the sprayed zircon coating prior to dipping in sillimanite was 8 hrs. or over.

Both methods of obtaining a thick coating gave satisfactory results when the ratio of ethyl silicate solution to methylated spirit in the spray mixture was adjusted from 1:5 to 1:2, with a percentage of hydrochloric acid to give a *p*H value within a certain range. Of the two methods, however, the more consistent results were obtained by the double-spraying treatment.

Fig. 3 shows a defect which sometimes occurred when the spraying with the normal zircon mixture was followed by a dip in the sillimanite mixture. The dip coating cracked, causing the zircon coating to crack also, and this resulted in veining at the surface of the castings, as shown in the illustration. The adhesion of the zircon-base coating to the sillimanite investment was good, and the surface of the castings was superior to any previously secured with sillimanite-sprayed coatings.

It was found during the investigations that the distance of the nozzle of the spray gun from the pattern being sprayed was important. If the pattern is too close to the nozzle, the coating is wet and "runs," and therefore does not give a uniform coating, while cracking invariably occurs. If the pattern is too far from the nozzle, the binder evaporates before the particles of refractory reach the pattern, and a powdery coating is obtained which has poor adhesion to the pattern. The optimum distance is about 18 in.

The relative merits of the three refractories as the base for the sprayed coatings, in making castings of high-melting points, are in conformity with their known physical characteristics,[10] as Table III shows.

The inversion of pure silica at 870 deg. C., and the attendant change in density, would indicate that cracking of the coating could take place when the mould is heated to 1,000 deg. C. prior to pouring. The higher dissociation-temperature of sillimanite should lend itself, as this investigation has shown, to the production of coatings suitable for the type of alloys under consideration, while the even higher dissociation-temperature of zircon would suggest that this material should prove more satisfactory than sillimanite.

A mention of two defects in the turbine blade castings, encountered during the investigation into the use of zircon as the base of the spray-coating, may be of interest. Surface-porosity (Fig. 4) near the feeder head was found in some of the early castings. This was traced to inadequate feeding and was eliminated by an adjustment in feeding technique.

A defect which takes the form of shallow circular depressions or ripples sometimes occurs on the concave face of the blades (Fig. 5). This type of defect

TABLE IV.—*Preparations Used for the Investment.*

Investment No.	"FF" sillimanite (fine).	"30 mesh" sillimanite (coarse).	Ratio Fine/coarse.	Ethyl silicate stock solution.	Methylated spirit.	Hydrochloric acid (S.G. 1.16).		Investment time.	Drying time at 35-45 deg. C.	Percentage loss in weight of sample dried, 100 hrs. at 110 deg. C.	Order of increasing moisture content.
						Ml.	Per cent.				
	Gm.	Gm.		Ml.	Ml.			In hrs.	In hrs.		
1	1,125	2,250	1:2	281	844	—	—	*	48	—	Discontinued after investing.
2	675	2,700	1:4	281	844	—	—	7	48	—	do.
3	482	2,890	1:6	281	844	—	—	3	48	11.0	3
4	375	3,000	1:8	281	844	—	—	3	48	6.5	1
5	307	3,070	1:10	281	844	—	—	3	48	7.7	2
6	375	3,000	1:8	281	844	0	0	3	48	7.3	3
7	375	3,000	1:8	281	838	5.6	0.5	3	48	7.4	4
8	375	3,000	1:8	281	833	11.25	1.0	3	48	6.1	2
9	375	3,000	1:8	281	827	16.85	1.5	3	48	6.0	1

* Not consolidated after 8 hours jolting.

appears to be due to entrapped air and can usually be corrected by more suitable methods of running, in conjunction with properly placed vents.

(b) For the Investment

An extensive series of experiments was carried out to determine a satisfactory investment composition. In the first place, investments were made in 4-in. dia. tubes with various ratios of fine to coarse sillimanite and ethyl silicate stock solution, with and without hydrochloric acid. The mixtures were vibrated and the times required for consolidation were noted. The investments were then dried in the normal way for a fixed time and afterwards cut in half. Samples were taken from the centre and the loss in weight on further drying was determined. In addition, abrasion tests were made, at this stage and after firing at 1,000 deg. C., and compressive strengths were determined on selected samples. The results of these tests supported the investment formula included in the description of the recommended procedure. Some of the results are given in Table IV. Indications have been obtained that zircon of suitable screen-analysis might make an excellent material for the investment, but it has not been possible so far to secure zircon sands of the required type.

(To be continued.)

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10 Chesters, J. H., "Steelplant Refractories," 1944 (United Steel Companies Limited, Sheffield).

Publications Received

The Fordell Railway, by J. C. Inglis and F. Inglis. Published by the Authors from The Colony, Larbert, Stirlingshire. Price 4s. 6d., post free.

Of interest to those engaged in the history of engineering, as the booklet deals with wooden waggon ways, which for a considerable time served some of the Scottish collieries so well.

The Consulting Engineer Year Book, 1947. Published by Princes Press, Limited, 147, Victoria Street, London, S.W.1. Price 15s. post free.

This substantial publication carries a list of consulting engineers together with some notes of a biographical character and indication of the branch of engineering in which the person has specialised. Details are given of the activities and officers of a few of the technical institutes. There are a few articles of real use to the consulting engineer, such as a list of British Standard Specifications germane to engineering and a small buyers' guide.

Stanton Training Centre

A complete foundry unit is a feature of a well-equipped training centre, opened at the works of the Stanton Ironworks Company, Limited, near Nottingham, on Friday, June 13, by Mr. A. G. Stewart, chairman of the Company. At the opening, many prominent figures in the industrial and educational world were present. Mr. F. Scopes, managing director of the Stanton Company, presided. Into this centre will come all boys entering the Company's works at Stanton, Holwell, and Riddings. Apprentices will attend for four months on a full-time basis and afterwards will return for two monthly periods each year for refresher courses. Non-apprentices will have a four-week basic course, but will be encouraged to return voluntarily for training in handicrafts. Linked up with the centre are courses at local technical colleges.

The foundry training section, one of the most interesting features of the centre, is designed to give instruction in the fundamental principles of good foundry practice. The only mechanical aids are the sand preparation and handling plant, comprising a knock-out grid with conveyor belt and magnetic separator for the return sand. Sand mixing is by a sand mill, equipped with an overhead batch loader and a bucket loader. Cores and moulds are dried in a brick-built core stove, with facilities for taking sample gases and temperatures. The metal-melting plant includes a cupolette with charging platform and spark arrester, and an oil-fired tilting crucible for non-ferrous metals. The foundry floor covers approx. 2,000 sq. ft. and is served by an overhead travelling crane. Provision is made for vertical casting in a casting pit. Fettling is carried out in an adjoining bay, equipped with shot-blasting plant, together with a dust collector, a double-ended grinding machine and pneumatically operated chippers and grinders. There are also at the centre, engineering and woodworking sections, a complete pattern shop, an electrical engineering bay, blacksmith's forge, welding booths, classrooms with film strip projector and epidiascope, and a technical library.

At a luncheon following the opening ceremony, Mr. Stewart congratulated all concerned with the planning of the centre and said it showed that Stanton intended to remain in the progressive forefront of anything connected with the welfare and social good of their employees. Mr. P. H. Wilson, O.B.E., deputy managing director, said the Company's interest in its employees' education dated from 1918, the present centre being the completion of a theoretical training scheme introduced in 1944. He revealed that the trainees would be taught the rudiments of trades other than their own. At the centre, the boy training to be a foundry worker would also work in the patternshop and *vice versa*.

Mr. R. W. Blount, of the Further Education Department of the Ministry of Education, in proposing a toast to the Company, congratulated it upon the centre. He pointed out that it had been built in ten weeks, whereas it took between two and three years to build a technical college, and it was some illustration of what could be done by private enterprise. Mr. Scopes suitably responded for the Company.

Imports and Exports of Iron and Steel

Board of Trade Returns for May

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in May and in the first five months of 1947. Figures for the corresponding period of 1938 are given for purposes of comparison.

Total Exports of Iron and Steel.

Destination.	May, 1947.	Five months ended May.	Five-twelfths of 1938.
	Tons.	Tons.	Tons.
Eire	4,044	23,980	23,216
Channel Islands	752	2,516	3,090
Malta and Gozo	172	1,693	960
Cyprus	165	978	690
Palestine	2,265	16,800	3,363
British West Africa	4,783	19,966	20,726
Union of South Africa	11,690	64,164	96,286
Northern Rhodesia	418	2,541	8,572
Southern Rhodesia	616	7,425	15,088
British East Africa	2,416	11,087	10,805
British India	8,838	43,685	66,116
Burma	4,404	20,056	7,713
British Malaya	2,521	16,609	27,743
Ceylon	1,227	5,311	10,846
Hong Kong	2,788	9,684	9,831
Australia	3,730	16,882	71,210
New Zealand	3,194	22,233	54,951
Canada	2,317	4,902	35,587
British West India Islands	2,440	13,433	18,437
Anglo-Egyptian Sudan	1,035	4,794	3,454
Other British Countries	3,977	17,096	7,482
Soviet Union	55	1,597	1,812
Finland	6,459	17,777	7,336
Sweden	10,011	35,251	4,989
Norway	3,964	21,284	8,447
Iceland	1,031	3,469	274
Denmark	13,745	43,692	36,356
Poland	235	398	1,036
Netherlands	10,015	43,807	21,483
Belgium	1,786	10,851	8,469
Luxemburg	32	588	43
France	629	9,679	5,578
Switzerland	1,375	6,692	1,159
Portugal	1,059	6,435	3,214
Spain	363	2,207	3,235
Italy	877	3,222	2,141
Greece	1,020	6,703	730
Turkey	959	6,216	5,732
Dutch East Indies	5,102	9,866	11,378
Dutch West India Islands	1,246	4,313	1,027
Belgian Congo	206	897	126
Portuguese East Africa	513	1,810	5,925
Syria	321	1,375	1,086
Egypt	6,618	20,792	14,337
Iraq	4,984	25,245	10,725
Iran	2,948	20,910	45,992
China	7,492	20,698	9,379
United States of America	719	5,597	911
Colombia	1,607	4,380	1,592
Venezuela	2,251	10,974	1,948
Ecuador	594	2,232	663
Peru	332	2,151	1,263
Chile	609	3,207	2,622
Brazil	2,180	14,467	7,079
Uruguay	460	4,279	3,161
Argentine Republic	4,071	32,999	33,065
Other Foreign Countries	4,458	24,244	37,798
Total	164,118	755,639	798,281

IMPORTS OF PIG-IRON into Eire in January last totalled 318 tons, valued at £4,422, against nil in January, 1946.

Total Imports of Iron and Steel.

From	May, 1947.	Five months ended May.	Five-twelfths of 1938.
	Tons.	Tons.	Tons.
British India	424	929	64,846
Australia	11,556	28,863	15
Canada	14,339	74,865	48,905
Other British Countries	55	1,199	2,332
Sweden	1,137	4,310	37,415
Norway	3,992	11,181	14,072
Belgium	2,070	12,181	114,032
Luxemburg	779	2,017	24,417
France	100	914	107,226
U.S.A.	29,106	101,130	83,622
Other Foreign Countries	157	6,555	63,224
Total	63,715	244,144	560,112
Iron ore and concentrates—			
Manganiferous (*Revised)	7,000	43,642*	25,951
Other sorts	644,039	2,623,599	2,125,778
Iron and steel, scrap and waste, fit only for the recovery of metal	48,947	124,157	263,418

Exports of Iron and Steel by Products.

Product.	May, 1947.	Five months ended May.	Five-twelfths of 1938.
	Tons.	Tons.	Tons.
Pig-iron	4,970	25,062	39,142
Ferro-alloys, etc.—			
Ferro-tungsten	102	333	215
Spiegeleisen and ferro-manganese	18	7,022	2,165
All other descriptions*	36	279	437
Ingots, blooms, billets and slabs	359	1,531	4,060
Iron bars and rods	494	1,901	1,332
Sheet and tinplate bars	—	44	5,158
Wire rods	106	1,052	1,325
Bright-steel bars	2,307	11,404	2,745
Other steel bars and rods	12,477	62,219	42,501
Special steel	1,511	6,995	2,055
Angles, shapes and sections	9,518	43,768	27,864
Castings and forgings	980	2,417	674
Girders, beams, joists and pillars	3,660	13,516	13,946
Hoop and strip	3,626	16,569	15,574
Plates, ⅛ in. thick and over	15,031	60,930	54,566
Black plates	3,704	12,240	6,057
Black sheets	3,764	17,642	26,463
Galvanised sheets	4,789	21,788	61,222
Tinplates	11,722	57,961	133,044
Tinned sheets	628	1,576	587
Terneplates	4	235	1,802
Decorated tinplates	50	800	1,820
Cast-iron pipes, up to 6-in. dia.	6,258	21,502	20,387
Do., over 6-in. dia.	3,260	14,285	17,901
Wrought-iron tubes	18,702	94,818	91,656
Radiators and central-heating boilers	415	1,507	1,679
Railway material	11,868	65,537	65,898
Wire	3,308	24,101	22,992
Cable and rope	2,908	11,235	6,833
Netting, fencing and mesh	1,500	6,474	3,924
Other wire manufactures	474	3,158	1,530
Nails, tacks, etc.	484	3,057	1,586
Rivets and washers	420	2,826	3,557
Wood screws	403	1,736	1,047
Bolts, nuts and metal screws	2,054	9,136	7,322
Stoves, grates, etc. (excl. gas)	442	2,422	2,918
Sanitary cisterns	61	286	1,172
Fencing material	976	3,069	2,137
Anchors, etc.	840	3,537	2,640
Chains	867	3,474	2,622
Springs	507	2,846	1,638
Hollow-ware	4,587	22,088	4,459
All other manufactures	23,928	91,261	89,625
Total	164,118	755,639	798,281

* The figures for 1938 are not completely comparable with those for subsequent years.

Pig-iron and Steel Production in Great Britain

Statistics for April, 1947

The following particulars relating to pig-iron and steel production in Great Britain have been extracted from the Statistical Bulletin for May, 1947, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in April, with the number of furnaces in blast at the end of the month; Table II, production of steel ingots and castings in April; and Table III, deliveries of alloy and non-alloy finished steel. Table IV summarises the activities of the steel industry as a whole during the six months ended April, 1947.

TABLE I.—*Weekly Average Production of Pig-iron and Blast-furnace Ferro-alloys in April*, 1947. (*Thousands of Tons.*)

District.	Furnaces in blast, 3.5.47.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants, and Essex ..	23	—	12.9	18.7	1.4	—	33.0
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Ches. ..	6	—	6.0	—	—	0.8	6.8
Yorkshire (incl. Sheffield, excl. N.E. Coast) ..							
Lincolnshire ..	11	—	18.2	—	—	—	18.2
North-East Coast	24	5.3	27.9	0.9	—	1.2	35.3
Scotland	8	0.7	8.1	2.2	—	—	11.0
Staffs., Shrops., Worcs. and Warwick ..	4	—	4.3	0 1	—	—	4.4
S. Wales and Monmouthshire	7	1.0	17.1	0.1	—	—	18.2
North-West Coast	7	11.4	—	0.2	—	0.7	12.3
Total ..	90	18 4	94.5	22.2	1.4	2.7	139.2
March, 1947 ..	92	18.6	81.0	20.0	1.7	1.8	123.1
April, 1946 ..	100	22.1	106.0	16.3	1.0	3.3	148.7

TABLE III.—*Weekly Average Deliveries of Alloy and Non-alloy Finished Steel.* (*Thousands of Tons.*)

Product.	1946.	1947 (1st 4 months).	1946	1947.	
			April.	March.	April.
Non-Alloy steel :					
Heavy rails and sleepers	9.0	7.1	11.3	7.4	6.5
Heavy and medium plates	30.9	29.0	32.3	25.8	32.1
Other heavy products	31.9	30.4	30.6	28.1	34.6
Light rolled products (excl. wire rods and alloy-steel bars) ..	48.9	47.5	46.1	49.2	50.5
Ferro-concrete bars	3.2	2.7	3.8	2.7	3.6
Cold-rolled strip ..	4.2	4.5	4.0	4.7	4.7
Bright steel bars ..	4.5	4.3	4.0	5.1	4.7
Sheets, coated and uncoated	22.4	24.0	20.6	22.2	25.8
Tin, terne and blackplate	10.4	11.8	9.6	9.9	12.3
Tubes and pipes ..	14.0	12.3	13.5	12.3	14.2
Steel wire	11.8	10.4	10.7	10.7	11.1
Tyres, wheels and axles	3.4	3.4	3.3	3.5	3.5
Forgings	4.9	4.6	4.4	4.7	4.9
Castings	2.9	2.7	2.6	2.9	2.8
Total	202.4	194.7	196.8	189.2	211.3
Alloy steel :—*					
Plates	0.3	—	0.2	—	—
Tubes and pipes ..	0.2	0.3	0.1	0.3	0.3
Bars, sheets, strip and wire	2.9	3.3	2.5	3.3	3.8
Drop forgings ..	1.2	1.1	1.0	1.0	1.2
Other forgings ..	0.4	0.4	0.3	0.4	0.5
Castings	0.6	0.6	0.5	0.6	0.6
Total	5.6	5.7	4.6	5.6	6.4
Total production† ..	208.0	200.4	201.4	194.8	217.7
Less Intra-industry conversion ..	16.4	14.7	16.8	15.6	17.4
Net U.K. deliveries ..	191.6	185.7	184.6	179.2	200.3
Add Deliveries of imported finished steel	—	—	—	—	—
Total finished steel ..	191.6	185.7	184.6	179.2	200.3

* Excludes high-speed steel

† Includes finished steel in the U.K. from imported semi-finished.

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in April*, 1947. (*Thousands of Tons.*)

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.*		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby, Leics., Notts., Northants and Essex	—	—	(Basic) 7.6	1.1	0.3	8.6	0.4	9.0
Lancs. (excl. N.W. Coast), Denbigh, Flints, and Ches.	1.3	17.9	—	0.4	0.3	19.1	0.8	19.9
Yorkshire (excl. N.E. Coast and Sheffield)								
Lincolnshire	—	19.3	—	—	0.1	19.3	0.1	19.4
North-East Coast	2.7	47.1	—	0.6	0.4	49.6	1.2	50.8
Scotland	3.8	30.7	—	0.9	0.6	34.6	1.4	36.0
Staffs., Shrops., Worcs. and Warwick	—	11.2	—	0.6	0.6	11.3	1.1	12.4
S. Wales and Monmouthshire	7.1	37.0	(Basic) 4.2	0.7	0.1	48.8	0.3	49.1
Sheffield	6.3	20.0	—	6.3	0.5	31.7	1.4	33.1
North-West Coast	0.5	2.7	(Acid) 3.4	—	0.1	6.6	0.1	6.7
Total	21.7	185.9	15.2	10.6	3.0	229.6	6.8	236.4
March, 1947	18.7	152.3	11.9	10.0*	3.1	189.2	6.8	196.0
April, 1946	24.3	199.8	17.6	7.7	2.7	246.3	5.8	252.1

* Including alloy steel.

(*Continued at foot of next page.*)

Mond Nickel Fellowships

In February, 1946, Sir William Griffiths, D.Sc., chairman and managing director of the Mond Nickel Company, Limited, addressed a letter to the Institute of Metals, and to the presidents of the Iron and Steel Institute, the Institution of Mining and Metallurgy, the Institute of British Foundrymen, and the Institution of Metallurgists, inviting them to co-operate in awarding annually for the next 15 years, a number of Fellowships, to be known as " Mond Nickel Fellowships." The Mond Nickel Company, Limited, offered to make available, over a number of years, the sum of £50,000 to be used for awarding these Fellowships. The five Institutes and Institutions accepted the offer and agreed to co-operate in awarding and administering the Fellowships, which will be awarded to persons of British nationality educated to university degree or similar standard, though they need not necessarily be qualified in metallurgy. There are no age limits, though awards will seldom be made to persons over 35 years of age. Each Fellowship will occupy one full working year. It is proposed to award up to five Fellowships each year of an average value of £750.

The Fellowships will be awarded with the following objects:—(*a*) To allow selected persons to pursue such training as will make them more capable of applying the results of research to the problems and processes of the British metallurgical and metal-using industries; (*b*) to increase the number of persons who, if they are subsequently employed in executive and administrative positions in the British metallurgical and metal-using industries, will be competent to appreciate the technological significance of research and its results; (*c*) to assist persons with qualifications in metallurgy to obtain additional training helpful in enabling them ultimately to assume executive and administrative positions in British metallurgical and metal-using industries; and (*d*) to provide training facilities whereby persons qualified in sciences other than metallurgy may be attracted into the metallurgical field and may help to alleviate the shortage of qualified metallurgists available to industry. The company wish to emphasise that the main object of the Fellowships is to assist persons capable of appreciating and applying the results of research, rather than to encourage research itself.

They will be awarded to selected candidates who wish to undergo a programme of training in industrial establishments and will normally take the form of travelling Fellowships—awards for training at Universities may, however, be made in special circumstances. Applicants will be required to state the programme of training in furtherance of which they are applying for an award as well as particulars of their education, qualifications and previous career. Full particulars and the necessary forms of application can be obtained from the Secretary, Mond Nickel Fellowships Committee, 4, Grosvenor Gardens, London, S.W.1. Completed application forms will be required to reach the Secretary of the Committee not later than September 1, 1947.

A.F.A. Elect New Officials

The following have been elected chairmen for 1947-49 of the various divisions of the American Foundrymen's Association:—

Brass and Bronze Division, Mr. Walter W. Edens, technical director, Ampco Metal, Inc., Milwaukee.

Educational Division, Mr. Fred G. Sefing, research metallurgist, International Nickel Company.

Grey Iron Division, Mr. Russell J. Allen, metallurgi-engineer, Worthington Pump & Machinery Corp., Harrison, N.J.

Malleable Division, Mr. Leon J. Wise, assistant to the president, Chicago Malleable Castings Company.

Pattern Division, Mr. Albert F. Pfeiffer, assistant general superintendent, Allis-Chalmers Mfg. Company, Milwaukee.

Sand Division, Dr. H. Ries, Ithaca, N.Y.

Steel Division, Mr. Laurence H. Hahn, metallurgical supervisor, Sivyer Steel Casting Company, Chicago.

PRESIDING AT THE annual meeting of Platt Bros. (Holdings), Limited, Mr. K. H. Preston, the chairman, said that their order-book of textile machinery now represented several years' work at maximum production. Although output was rising, current monthly figures being some 60 per cent. higher than 12 months ago, production was still well below their target. The company was severely handicapped by lack of timber, and no steel priority had been given for textile machinery.

PIG-IRON AND STEEL PRODUCTION IN GREAT BRITAIN (*Continued from previous page.*)

TABLE IV.—*General Summary of Pig-iron and Steel Industry.* (*Weekly averages in Thousands of Tons.*)

Period.	Iron-ore output.	Imported ore consumed.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy).			Steel stocks held by producers, etc.*
					Steel imports.	Output of ingots and castings.	Deliveries of finished steel.	
1938	228.1	89.2	130.0	117.9	16.2	200.0	—	—
1946	234.1	115.4	149.3	147.0	8.3	244.1	191.6	1,189.7
1946—November	221.7	127.3	153.9	160.0	8.7	263.7	208 4	1,068.5
December	216.7	125.7	153.2	143.3	4.9	236.3	185.8	1,045.3
1947—January	218.0	127.4	150.1	144.5	5.1	239.8	196.0	1,067.5
February	146.4	116.1	126.1	122.7	10.1	206.2	161.2	1,000.5
March	172.1	111.0	123.1	117.7	12.7	196.0	179.2	983.2
April	207.9	122.1	139.2	145.9	9.3	236.4	200.3	916.7

* Stocks at the beginning of the years and months shown.

Company News

(Figures for previous year in brackets.)

Geo. W. King—Dividend of 12½% (same).

Ruston & Hornsby—Dividend of 12½% (same).

Henry Hope & Sons—Dividend of 7½% (10%).

Glacier Metal Company—Dividend of 7½% (same).

C. Lindley & Company—Interim dividend of 5% (10%).

British Lead Mills—Interim dividend of 12½% (same).

Darlington & Simpson Rolling Mills—Dividend of 9% (5%).

Mitchell, Shackleton & Company—Interim dividend of 3% (nil).

Swan, Hunter & Wigham Richardson—Interim dividend of 4% (same).

J. Stone & Company—Final dividend of 15%, making 25% (same)

Allied Ironfounders—Final dividend of 12½% (7½%), making 17½% (12½%).

General Cable Manufacturing Company—Interim dividend of 20% (8%).

Warne, Wright & Rowland—Final dividend of 32½% (17½%), making 40% (25%).

British Steel Constructions (Birmingham)—No dividend is recommended (7½%).

Banister, Walton & Company—Final dividend of 20% and bonus of 5%, making 30% (same).

Thomas Bolton & Sons—Final dividend of 5% (same) and bonus of 2½% (nil), making 10% (7½%).

G. Hopkins & Sons—Final dividend of 11½% on increased capital (same), making 17½% (same).

Morgan Crucible Company—Final dividend of 8¾% (7½%), making 12½% (11¼%) on increased capital.

Mountstuart Dry Docks—Dividend of 8% (nil) on the preferred ordinary shares and 10⅝% (6%) on the deferred ordinary shares.

Herbert Terry & Sons—Final dividend of 1s. per share, making 1s. 6d., or 30%, per 5s. share (dividend of 20% and bonus of 5%, making 35%).

Railway & General Engineering Company—Net profit for the year ended March 31, £2,746 (£3,039); dividend of 7½%; forward, £7,917 (£7,925).

Harris & Sheldon—Net profit for 1946, after tax, etc., £16,704 (£14,223); final dividend of 7½%, making 10% (same); general reserve, £10,000 (£5,000); forward, £26,782 (£27,382).

Mirrlees Watson Company—Trading profit for the year ended March 31, £33,449 (£46,947); available after tax, etc., £25,637 (£30,738); dividend of 8% (same); forward, £4,920 (£9,160).

Rotherham Forge & Rolling Mills Company—Net profit for the year ended March 31, £13,958 (£14,985); to reserve, £5,000 (same); final dividend of 10% (same), making 15% (same); forward, £11,626 (£11,662).

Oliver Pell Control—The directors state that it seems provident to withhold payment of an interim dividend on the preference shares until the final accounts for the year ended March 31 last are available.

Ambrose Shardlow & Company—Net profit for the year ended March 31, after tax, etc., £45,435 (£33,736); to general reserve, £20,000 (£10,000); contingencies, nil (£15,000); final dividend of 10% (5%), making 12½% (7½%); forward, £17,909 (£11,724).

F. Francis & Sons—Profit for 1946, including dividends from subsidiaries, £88,180 (£68,200); to tax, £50,000 (£40,000); dividend equalisation reserve, nil (£20,000); final dividend of 15% (11%), making 20% (15%); forward, £30,500 (£20,370).

Twyfords—Net profit for the year ended March 31, after tax, depreciation, etc., £51,097 (£43,127); to employees' fund, £5,000 (£4,000); reserve for works reconstruction, £10,000 (£20,000); final dividend of 12%, making 15% (10%); forward, £39,390 (£32,053).

Bentley Engineering Company—Dividend of 40%, less tax (20%, tax free). In January last an issue of 162,500 ordinary shares of 4s. was made and the then £1 ordinary shares were subdivided into 4s. shares. The new shares rank for the 1946 dividend.

Zinc Corporation—Final dividend for 1946 of 5s. 6d. (English currency) per ordinary share of 10s. or per £1 unit of ordinary stock (which rank equally in all respects), making 7s. 6d. gross (4s. 1.5d.) per share or unit, as compared with 2s. 6d. gross (1s. 6.75d. net) per share or unit for 1945.

Coltness Iron Company—Net profit for 1946, £360,025 (£190,207); second interim dividend of 2s. 6d. per share, making 3s. 3d. (same); the directors do not intend to recommend payment of a final dividend; to redemption and depreciation account, £8,000; forward, £504,985 (£298,678).

Park Gate Iron & Steel Company—Profit for the year ended March 31, including income from investments, and after taxation, etc., £161,295 (£162,918); to depreciation, £40,000 (same); debenture interest and sinking fund, £28,000 (same); dividend of 10% (8%); forward, £91,149 (£55,738).

Newall Engineering Company—Consolidated trading profit to March 31, after depreciation, £43,511 (£39,134); to tax, £21,500 (£20,000); net profit, £22,011 (£19,134); final dividend of 15% (20%) on the old ordinary shares, making 30% (same); final dividend on the new ordinary shares of 7½%; forward, £16,957 (£13,401).

Harland Engineering Company—Credit balance after crediting taxation and other recoveries and providing for income tax, depreciation, and directors' fees, £15,990 (£17,296); ordinary dividend, including shares issued in February, 1946, of 7% (same); general reserve, nil (£7,000); forward, after preference dividends to September 30, 1947, £18,028 (£16,002).

Garrard Engineering & Manufacturing Company—Net profit to January 31, after crediting £24,855 (nil) E.P.T. recoverable, tax, depreciation, etc., £25,655 (£28,489); to reserve, nil (£7,000); additional depreciation on buildings, £10,000 (£5,000); final dividend of 12½% on increased capital (12½% and bonus of 5%), making 25% (30%); forward, £23,517 (£22,415).

N. Greening & Sons—Trading profit for the year ended April 30, £107,753 (£37,128); interest, £7,492 (£7,296); to tax, £65,000 (£19,407); depreciation and obsolescence, £5,000 (nil); repairs, nil (£2,000); fees, £800 (same); W.D.A., nil (£4,644); stock reserve, £5,000 (nil); general reserve, £25,000 (£10,000); final dividend of 10% (7½%) and bonus of 5% (nil), making 17½% (10%).

Metal Box Company—Net profit for the year ended March 31, after provision for debenture interest and taxation, £387,709 (£264,210); to preference dividend, £40,048 (£36,187); development and reorganisation reserve, £150,000 (£75,000); final ordinary dividend of 15% (12½%), making 20% (20%, including special bonus of 2½%) on increased capital; forward, £219,470 (£193,628).

Pease & Partners—Trading profit for the year ended March 31, £270,243 (£304,519); interest and dividends from subsidiaries, £144,416 (£137,997); interest, dividends, and rents receivable, £42,312 (£58,527); debenture interest, £5,191 (£16,000); taxation, £80,000 (£100,000); net profit, £308,792 (£311,665); to contingencies, etc., reserve, £70,000 (same); dividend of 10% (same); forward, £315,412 (£313,608).

Siemens Bros. & Company—Trading profit for 1946, including approximately £110,000 in respect of previous years and income from subsidiaries, £372,679 (£427,183); E.P.T. recoverable, £410,000 (£215,000); income tax, £200,000 (£150,000); depreciation, £123,965 (£164,929); deferred repairs, £90,000 (£25,000); net profit, £364,888 (£290,888); to contingencies, £140,000 (nil); dividend of 7½% (same); forward, £698,279 (£642,141).

F. H. Lloyd & Company—Trading profit to March 31, £111,245 (£61,685); E.P.T. repayable, nil (£25,868); meeting fees, nil (£1,698); sundry receipts, £30 (£319); to interest, £423 (£1,640); directors' fees, £850 (same); staff pensions, £2,827 (£3,379); depreciation and obsolescence, £25,054 (£19,933); tax, £39,500 (£28,302); general reserve, £13,588 (£15,000); preference dividend, £3,575 (£1,313); final ordinary dividend of 7%, making 10% on increased capital (10%); forward, £11,752 (£11,044).

Hattersley (Ormskirk)—Trading profit to March 31, £197,095 (£133,801); interest and rents, £3,929 (£4,289); to depreciation, £11,451 (£6,628); directors' fees, £500 (same); profit on sales of investments, £6,250 (nil); to tax, £116,915 (£78,736); obsolescence and replacements, £13,718 (£5,000); general reserve, £30,000 (£20,000); final dividend of 11½% and bonus of 2½%, making 20% (same); distribution of 2½%, not subject to tax, out of profits on sales of investments; forward, £15,884 (£14,944).

Deritend Stamping Company—Trading profit for the year ended February 28, £11,152 (loss £30,111); E.P.T. refund claims, £42,930 (£96,646); profit on sale of property, £1,686 (nil); to depreciation of freehold properties, £2,000 (same); written off plant, £10,500 (nil); staff pensions premiums, £2,671 (£2,257); directors' fees, £1,200 (£900); income tax, £11,941 (£24,582); deferred repairs, £9,500 (£15,000); general reserve, £10,000 (nil); final dividend of 5%, making 10% (same); forward, £47,294 (£48,908).

Ransomes & Rapier—Trading profit for 1946, £177,476 (£163,019); to maintenance, £25,337 (£50,630); depreciation, £20,151 (£20,212); debenture interest, £3,337 (£3,420); other charges, £4,207 (£2,666); pensions, etc., £18,978 (£19,778); bonus to employees, £12,135 (£18,843); fees, £6,905 (£3,274); A.R.P., £2,927 (£1,770); taxation, £35,833 (£11,765); net profit, £47,666 (£30,661); depreciation on buildings, £7,000 (nil); to general reserve, £15,000 (£10,000); dividends, £25,917 (£19,225); final ordinary dividend of 5% net (4%), making 7% (6%), tax free, including 2½% on the new ordinary shares; forward, £3,098 (£3,349).

Tees-side Trade with South America

Prospects of a revival of trade between Tees-side and South America are indicated in spite of the restrictions placed on imports from this country. The 7,000-ton liner, Memling, recently took on a cargo at the L.N.E.R. Dock, Middlesbrough, to which several Tees-side firms contributed their quota. The cargo included 850 tons of pig-iron fram E. Hind (South Bank), Limited, 350 tons of pig-iron from Pease & Partners, Limited, and a quantity of spun cast-iron pipes from Cochranes (Middlesbro') Foundry, Limited. Other Tees-side firms contributing to the cargo were Dorman, Long & Company, Limited, Richard Hill & Company, Limited, Power-Gas Corporation, Limited, and Imperial Chemical Industries, Limited, Billingham Division.

THE HEAVY ARMOUR PLATE departments of Thos. Firth & John Brown, Limited, Sheffield, are to be converted to the manufacture of steelworks' equipment. A private company, F.B. Engineers, Limited, has been formed with a capital of £50,000 to handle the new business.

H.M. COMMERCIAL COUNSELLOR at The Hague has reported to the Export Promotion Department that the rolling equipment of the Royal Netherlands blast furnaces and steelworks has resumed production. The equipment was looted by the Germans in March, 1943, and was brought back from Germany with the co-operation of the British occupation authorities at the end of last year. The plant has been reconditioned. The rolling equipment produces heavy steel sheets especially for the shipbuilding industry and has an annual capacity of 170,000 tons of heavy sheets. Production for the time being is estimated at 60,000 tons annually.

Personal

DR. C. H. DESCH has been nominated a member of the Academie des Sciences of France.

MR. P. L. CRAWFORD has resigned from the board of Burco, Limited, manufacturing electrical and mechanical engineers, of Burnley.

MR. E. G. BISSEKER is resigning from the board of the General Cable Manufacturing Company, Limited. MR. RALPH A. PANTLIN will join the board.

MR. S. E. PROCTOR, general manager of the coal division of Austin Hoy & Company, Limited, engineers, etc., of Aylesbury, has been elected a director of the company.

MR. G. W. LACEY has been appointed a member of the Council of Industrial Design. He is a director and general sales manager of the British Aluminium Company, Limited.

MR. D. I. LESLIE DORAN, who has been appointed technical officer to the Engineering Centre in Glasgow, was recently in charge of engine developments with Rolls-Royce, Limited.

MR. C. C. BOOTH, J.P., has been appointed by the Institute of British Foundrymen as its official representative on the Board of Governors of the National College for the Foundry Industry.

MR. JAMES ROSS, works manager of the Dalzell Steel Works, Motherwell, of Colvilles, Limited, has been appointed director of the Iron and Steel Trades Employers Federation from August 1.

MR. DUDLEY W. BROUGH has been appointed to succeed SIR ROBERT BARLOW as managing director of the Metal Box Company, Limited. Sir Robert retains his office as full-time chairman of the company.

MR. E. S. WADDINGTON, of Philips Industrial (Philips Lamps, Limited), has been elected vice-chairman of the resistance-welding machine section of the British Electrical and Allied Manufacturers' Association.

MR. G. B. MCCORMICK, acting Principal Deputy Director of Armament Supply, has been appointed to succeed SIR ROBERT WHARHIRST as Director of Armament Supply on October 1, when Sir Robert retires.

MR. J. B. MCGILLIVRAY, who has been associated with James Howden & Company, Limited, engineers, of Glasgow, for 54 years and a member of the board since 1922, is retiring. MR. JAMES S. NIVEN and MR. HENRY L. PAUL have been appointed to the board.

MR. DOUGLAS P. MUIRHEAD, chief engineer of Jones & Campbell, Limited, Torwood Foundry, Larbert, and of James Jones & Sons, Limited, suppliers of colliery timber, etc., also of Larbert, has been elected a member of the National Council of the Institution of Engineering Inspection.

MR. WALTER JOHNSON resigned the position of secretary of Thos. W. Ward, Limited, Sheffield, at the end of June. He was entertained at luncheon recently by the chairman, directors and local directors of the company at the Royal Victoria Hotel, Sheffield, when he received a presentation to mark the occasion. Mr. Johnson, who has completd 59 years' service with the company, has held the position of secretary for 27 years. He still retains his directorship of the company. MR. HERBERT BERESFORD has been appointed to succeed Mr. Johnson as secretary.

Wills

HOMER, J. R., of Pedmore, Stourbridge, chain manufacturer £15,712

CARTER, JAMES, of Bangor, Co. Down, for many years Irish agent and Belfast manager of the Wigan Coal & Iron Company, Limited £9,911

HOLDEN, H. S., chairman of Ellerman Engine Works, Limited, Storry Smithson & Company, Limited, manufacturers of anti-fouling compositions, of Hull, and a director of Amos & Smith, Limited, marine engineers, foundrymen, etc., of Hull, and a member of the board of many other companies... £77,825

FRAME, DAVID, of Bray, Co. Wicklow, chairman and managing director of the Hammond Lane Foundry Company, Limited, Hammond Lane Metal Company, Limited, and a director of Douglas Iron Works, Limited, Fyffe Couplings (Ireland), Limited, Wellington Hollow-Ware, Limited, Western Iron Company, Limited, and other companies £117,587

Gazette

PLASKYNASTON FOUNDRY COMPANY, LIMITED, is being wound up voluntarily, in view of the fact that the company's property at Acrefair has been sold. Mr. W. R. Yaxley is the liquidator,

E. C. WINTER & SON, LIMITED, non-ferrous founders, of New Malden, Surrey, is being wound up. Mr. J. R. Taylor, of Godwin & Taylor, chartered accountants, of London, is the liquidator.

THE ALDBOURNE ENGINEERING COMPANY, LIMITED, having filed a declaration of solvency, and having realised all its trading assets, is being wound up. Mr. M. Owen, Victoria Chambers, Swindon, is the liquidator.

THE PARTNERSHIP BETWEEN William Frederick Arnold and Robert Henry Cram, carrying on business as general engineers, etc., at 35-41 and 51-53, Brighton Road, Surbiton, Surrey, under the style of the C. & A. Engineering & Construction Company, has been dissolved by mutual consent. Debts will be received and paid by R. H. Cram, who will carry on the business in the future.

THE COMPANIES' REGISTRATION OFFICE give notice that the names of the undermentioned companies have been struck off the register, and are thereby dissolved:—Bell Machinists, Limited; Goyt Engineering Company, Limited; Multi-Engines, Limited; Steel & Alloy Productions, Limited; Tyler & White Engineering Company, Limited.

WORK IS IN HAND on the erection of a new factory at Stockton-on-Tees for the Hugill Forge & Engineering Works.

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1. Core being lowered into mould
2. Pouring the metal
3. Finished casting in transit

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News in Brief

ADDITIONS TO THE Railway Appliance Works, Darlington, of Henry Williams, Limited, are in hand.

THE NAME OF THE Stockton Steel Foundry Company, Limited, has been changed to Head Wrightson Steel Foundries, Limited.

WORK HAS STARTED on the construction of an additional shipbuilding berth at R. & W. Hawthorn, Leslie & Company's yard at Hebburn.

THE DIRECTORS OF Walmsleys (Bury), Limited, machinery makers, etc., announce that in future the accounts will be made up to June 30 in each year.

THE NEWLY CONSTITUTED British Food Machinery Manufacturers' Association has been admitted to membership of the British Engineers' Association.

COMMENCING THIS MONTH, a five-day week is to be worked in the Cleveland ironstone mines. Polish labour is also being recruited to make good the man-power shortage in the mines.

FREE VISAS and 50 per cent. reduction on Czechoslovak railways will be allowed to tourists visiting the Prague International Fair, which takes place next September. Other concessions will also be made.

W. G. TURRIFF, LIMITED, Leamington Spa, have been awarded the contract for the foundations of an aluminium bridge to cost £86,000 at Hendon Junction, Sunderland. The bridge itself will be erected by Head, Wrightson Alloys, Limited.

THE HUNSLET ENGINE COMPANY, LIMITED, has recently shipped to Alberta one of its 10-ton, 50-b.h.p., flameproof Diesel locomotives, which is to be put into heavy coal haulage underground. It is the first fully-flameproof locomotive to be set to work in Canada.

COLLIERY ENGINEERING, LIMITED, and Aerex, Limited, of Sheffield, have reopened their office at 28, Sandhills, Newcastle-upon-Tyne (telephone: Newcastle 28005). Mr. S. Oswald will be the engineer in charge of the office and will cover the whole of the North of England and Scotland.

THE ANNUAL REPORT of Ransomes & Rapier, Limited, states that the works are full to capacity, and a request has been received from the Government to increase the excavation output in 1948. The necessary physical steps have been taken to this end, but the success of the plan must be dependent on the increased availability of suitable man-power.

THE BOARD OF TRADE states that, though a small quantity of German engineering equipment has been received in this country as part of war reparations, it does not include generating plant. Discussions have been proceeding in Germany with a view to bringing German generating plant to Britain to ease the electricity supply position, but no real progress appears to have been made in this respect.

THE BRITISH DELEGATES, numbering about 150, to the eighth International Management Congress, which is taking place in Stockholm from July 3 to 8, will be led by Lord Leverhulme, chairman of the British Management Council. Representatives from several Government departments, the F.B.I., the T.U.C., the Council of the British Institute and from various institutions will attend the Congress.

MANUFACTURERS OF resistance welding machines, who form a section of "Beama," state that, in spite of the difficulties they are experiencing in obtaining raw materials, exports of spot, seam, projection and flash resistance welding machines during the first few months of 1947 were greater than the figure for the corresponding period of 1946, while the volume of outstanding orders for both home and overseas has been reduced slightly.

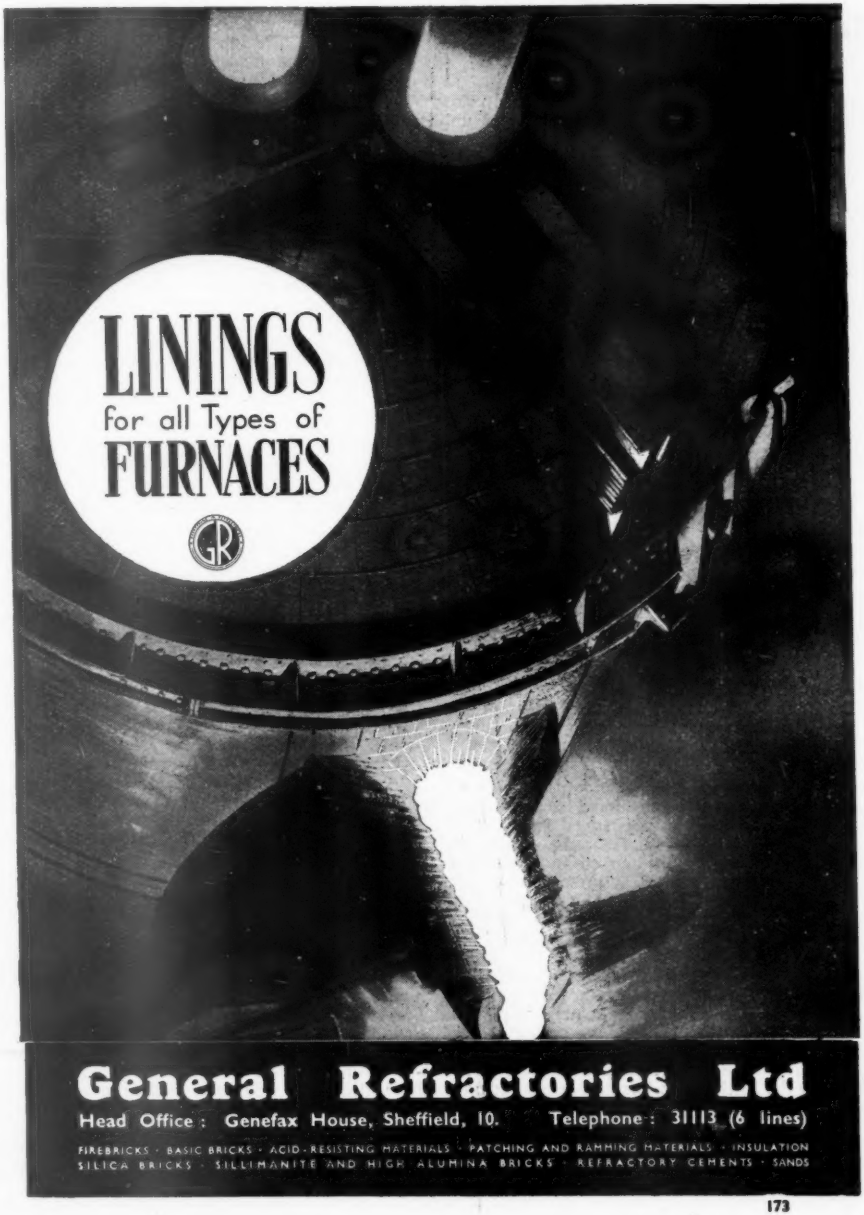
THE WORKS OF Irish Steel, Limited, at Haulbowline, which have been in the hands of a receiver since January last, will shortly be taken over on behalf of the Eire Government. The receiver advertised the company's assets as a going concern, but no acceptable offer was received. A private limited company, with a token capital, is to be formed to purchase the assets of Irish Steel, Limited, the finance being provided by borrowings guaranteed by the Government.

A "DESIGN WEEK," the first of a series to be held in the main industrial centres of the country, planned by the Council of Industrial Design in co-operation with the Federation of British Industries and the Associations of Chambers of Commerce, will be held at Newcastle-upon-Tyne from July 7 to July 12. The programme will include conferences of industrialists and retailers, which will be addressed by speakers prominent in industry, commerce, education and in the field of industrial design.

Indian Steel Company's Offer for Darwins, Limited

A circular to the ordinary shareholders of Darwins, Limited, Sheffield, contains further information of the offer by Rahon Steel, Limited, to purchase the whole of the ordinary share capital of 1,028,300 10s. shares of Darwins at a price of 9s. 6d. per share cum the right to receive any dividend on the ordinary shares in respect of the year ended March 31, 1947. The directors consider that the offer is favourable and have accepted in respect of 636,324 ordinary shares of 10s. held by them and companies in which they are interested, and they recommend acceptance by the other holders.

Part of the terms of the offer is that, after completion of the purchase of the 636,324 ordinary shares, the chairman, Mr. A. P. Good, and two of the other directors, Mr. H. W. Dunn and Mr. I. W. W. Shepherd, shall retire as chairman and directors in consideration of the payment to them by Rahon Steel, Limited, of £3,000, £1,000 and £1,000 respectively, as compensation for loss of office. In addition, Rahon Steel, Limited, will appoint Sir Joseph Bhore and Dr. Naraina Das Chopra as additional directors to represent them on the board. The other directors, the managing director, Mr. W. J. Wigney and Mr. S. W. Young and Mr. W. W. Wood will remain on the board.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Raw Material Markets

Iron and Steel

Restoration of pig-iron production is tediously slow. More iron is needed, but cannot be provided until more coke is forthcoming, and in the meantime the most careful supervision of distribution is necessary to avoid serious difficulties. Expansion of steel-ingot production will necessarily call for heavier tonnages of basic iron, but the steelworks are not so badly off. It is at the foundries that the more serious difficulties are encountered, although shortage of iron is only one of the obstacles which are retarding the output of light castings. There was a fairly big shipment of refined iron from the Tees to Argentina recently, but all other grades of iron are too scarce to permit of exports.

Rather bigger tonnages of home-produced steel semis are being supplied to the re-rolling mills and these are all greedily absorbed. On the other hand, the provision of more imported material is still only a promised development which may mature later in the year. Meanwhile, the re-rolling mills are still working well below capacity and provide a ready outlet for crops and defectives as well as prime billets, sheet bars, etc.

Rollers of plates and sections have fallen into heavy arrears with their deliveries, and there is no early prospect of any substantial improvement. Such is the congestion at the mills that steelworks are disinclined to accept any further orders even for the first priority groups. Moreover, distribution of finished material is often held up by the shortage of railway wagons. Sheet mills are similarly overburdened with orders and are unable to make much impression on the weight of business in hand.

Non-ferrous Metals

Although, generally speaking, the world price of copper is 21.50 cents per lb., there have been instances reported where odd parcels have changed hands at as low a figure as 20.25 cents per lb., f.a.s. Fabricators in the United Kingdom are heavily booked and consumption will probably be maintained at present levels for some time, but, in view of the high U.K. raw copper price, compared with international levels, users are buying very little. In his statement circulated with the report of Selection Trust Company, Mr. A. Chester Beatty, referring to the big rise in copper prices in the opening months of this year, said that the rise was due to the statistical position of the copper market, aggravated, in his opinion, by the bulk-buying policy of the British Government.

The consumption during May of unalloyed copper for tubes is given by the British Non-ferrous Metals Federation as being 3,088 tons, and unalloyed copper for castings and miscellaneous products as 500 tons. In the alloyed copper section, the consumption is given as 1,313 tons (copper content 918 tons) and 5,610 tons (copper content 4,488 tons) for tubes and castings respectively.

Copper imports into the United Kingdom for May were only 22,023 tons, whereas consumption of the virgin metal amounted to 32,564 tons. Consequently, the increase gained in stocks in April will have been largely offset.

In view of the downward trend of tin stocks in the United States and the United Kingdom, the world's tin supply position looks like being fairly tight and the stringency can be expected to last into 1948. A great deal, of course, depends upon the speed of restoration of output in Malaya and the Dutch East Indies. The Office of Materials Distribution of the U.S. Commerce Department estimates that, under present controls, American domestic tin consumption for the remainder of the year will be about 7,595 tons a month, and if Congress fails to extend the controls, available reserves will be used up before the end of the year.

There is still an acute shortage of lead and it would seem that it will be some considerable time before imports into the United Kingdom can be raised to a level high enough to meet all requirements.

Obituary

MR. MARK OSBORNE, of Osborne & Company (Glasgow), Limited, metal merchants, died on June 19.

MR. TOM CARRUTHERS, chief engineer of the Workington branch of the United Steel Companies, Limited, has died suddenly. He was 61 years of age.

MR. CYRIL HAMMERSLEY, whose death occurred recently, was a director of S. Noton, Limited, machinists, of Oldham. He was manager of their Oldham branch.

MR. NEIL MACINNES, secretary of the Greenock Dockyard Company, Limited, died on June 20 after a short illness. He joined the firm 34 years ago and had been secretary for 23 years.

MR. F. PERCY CLARKE, for many years general manager of the Cargo Fleet Ironworks of the Cargo Fleet Iron Company, Limited, Middlesbrough, died on June 21 after a long period of failing health. He was a member of the Iron and Steel Institute and a past-president and chairman of the Cleveland Ironmasters' Association.

MR. ANDREW NISBET MCQUISTAN, a director and general manager of the South Durham Steel & Iron Company, Limited, and the Cargo Fleet Iron Company, Limited, was found fatally gassed at his home at Darlington on June 21. He was one of the most prominent industrialists on Tees-side and a man of international reputation. He began his career in Glasgow, went to Tees-side as manager of Cochranes (Middlesbro') Foundry, Limited, and rapidly rose to the chief executive position in the South Durham group. Mr. McQuistan was a former member of the Executive and Council of the British Iron and Steel Federation. He travelled extensively on the Continent and in the United States in connection with iron and steel developments. During the war he organised a school of welding for women at Stockton, as a result of which women were trained to build light tanks. He was 67 years of age.